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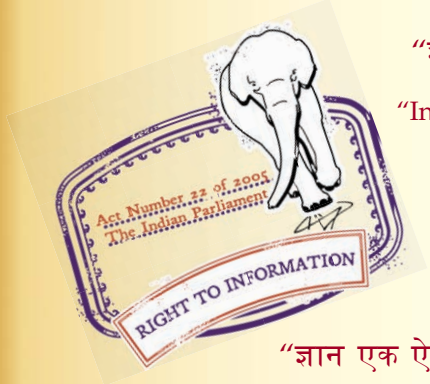

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Indian Standard

METHODS OF TEST FOR VULCANIZED RUBBERS

PART 5 ADHESION OF RUBBERS TO TEXTILE FABRICS

(Second Revision)

(Third Reprint JUNE 2004)

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PART 5 ADHESION OF RUBBERS TO TEXTILE FABRICS

(Second Revision)

(*Page* 4, *clause* 1.1, *line* 8) — Insert 'which is given in Annex A' After 'employed'.

(*Page* 9) — Insert the following after Fig. 3:

'ANNEX A
(*Clause* 1.1)

METHOD FOR TESTING OF ADHESION OF RUBBERS TO TEXTILE FABRICS FOR HOSES LESS THAN 50 mm ID

A-1 From woven-jacketed rubber lined hose, cut adhesion test specimens all transversely from the samples in rings 25 mm in width using a sharp tool that will have clean edges. On hoses 6.5 to 49.9 mm in inside diameter test the specimens in ring form and refer to them as ring specimens. Cut adhesion specimens from hose less than 6.5 mm in inside diameter longitudinally from the hose. Since the width of these specimens will be less than 25 mm. Determine the adhesion on the contact width of the test specimen.

A-2 SAMPLE PREPARATION

A-2.1 Ring Specimen

A-2.1.1 Mount the article on a smooth, close-fittings, slightly tapered wooden mandrel.

A-2.1.2 Rotate the mandrel and cut 25 mm wide ring sections by forcing a sharp pointed knife gradually through article.

A-3 The sample should be tested in accordance with 7.'

(PCD 13)

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PART 5 ADHESION OF RUBBERS TO TEXTILE FABRICS

(Second Revision)

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(*Continued on page* 10)

Indian Standard

METHODS OF TEST FOR VULCANIZED RUBBERS

PART 5 ADHESION OF RUBBERS TO TEXTILE FABRICS

(Second Revision)

0. FOREWORD

0.1 This Indian Standard (Second Revision) was adopted by the Indian Standards Institution on 13 May 1986, after the draft finalized by the Rubber Products Sectional Committee had been approved by the Petroleum, Coal and Related Products Division Council.

0.2 This standard was first published in 1965 and revised in 1983 to align it with ISO/R 36-1969 ' Determination of the adhesion strength of vulcanized rubbers to textile fabrics, issued by the International Organization for Standardization.

0.3 In the first revision, two methods were prescribed, namely, Method A, Machine method, based on ISO/R 36-1969 and Method B based on BS 903 (Part A - 12)-1959. Lately British Standards Intitution (BSI) has revised the above standard and have retained the 'machine method' deleting the ' static mass method '.

0.4 Accordingly in the second revision ' Static mass method ' which is also not internationally approved, has been deleted for obvious reasons like lack of precision and in accurate results. ' Machine method ' which is based on ISO/DIS 36 Rubber Vulcanized — Determination of adhesion to textile fabric has been retained. This method covers procedure for measuring the force required to separate, by stripping two plies of fabrics bonded with rubber or a rubber layer bonded with fabric ply. Further by using this method variation in adhesion strength over the test piece may also be determined. Apart from this all other changes considered necessary to align this standard with International standards or the National standards of other countries have also been included.

0.5 The method covered in this standard is not applicable to proofed fabrics for which a separate method has been prescribed in IS : 7016 (Part 5)-1973*.

*Methods of test for coated and treated fabrics: Part 5 Determination of coating adhesion.

0.6 In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2-1960*.

1. SCOPE

1.1 This standard (Part 5) prescribes a method for the determination of the adhesion of two plies of fabric bonded with rubber, or a rubber layer and a fabric ply bonded together. This method is applicable when the ply surfaces are approximately plain or cylindrical as in the case of belting, insertion sheet, hose and tyre careasses. For surfaces which contain sharp bends, angles or other gross irregularities that are not possible to be avoided, and for hose of internal diameter of less than 50 mm, special methods should be employed. This method is not applicable to proofed fabrics.

2. TERMINOLOGY

2.0 For the purpose of this standard the following definition shall apply.

2.1 **Peak** — A point at which the slope of a trace changes from positive to negative.

2.2 **Median** — If n measured values are arranged in increasing order of magnitude and numbered 1 to n, the median of these n values is $\frac{(n+1)}{2}$ th value, if n is odd. If n is even the median lies between the $\frac{(n)}{2}$th and $\left(\frac{n}{2}+1\right)$th value, and is not defined uniquely. Unless otherwise specified, it may be taken to be the arithmetic mean of these two measured values.

2.3 **Range** — The difference between the greatest and the smallest observed values of a quantitative characteristic.

2.4 **Complete Trace** — The section of the graphical plot of force versus time, between the time at which the first peak occurs and the time at which the test is terminated.

2.5 **Adhesion Strength** — Force required to cause a separation at the interface of the assembled components.

NOTE — Any separation occurring at any other point, for example, inside either component under test, is a failure of the component material; such separation should be reported and should not be considered as indicating an adhesion strength. In such cases, the adhesion strength is not less than the strength of the weakest component involved.

*Rules for rounding off numerical values (*revised*).

3. OUTLINE OF THE METHOD

3.1 The method of test covered in this standard prescribes the procedures for measuring the force required to separate, by stripping, two plies of fabrics bonded with rubber or a rubber layer bonded with a fabric ply, of standard dimensions, in the form of a flat strip or a cylinder.

4. TEST PIECE

4.1 Strip Test Piece — The test piece shall be 25 ± 0·5 mm wide and of sufficient length to permit separation over a length of at least 100 mm. The minimum thickness of the constituent components, or of one of them, shall be such that the weakest component may transmit the force necessary for separation without break. The thickness shall be suitably reduced, if necessary, to a maximum of 4 mm (*see* Note 1) and in such a manner that the separation interface is central (*see* Note 2) within the strip in ordre to ensure that the line of separation of the plies, during the test, lies as close as possible to the plane of the axis of the strips, of the test piece held in the grips (*see* Fig. 1).

NOTE 1 — Since one-ply thickness will not be greater than 1 mm and even in laboratory moulded test-pieces, 2 mm on each side of interface is adequate as also the practicable minimum.

NOTE 2 — Only in case of ex-type tread casing on tread/breaker samples with the tread rubber have to be buffed.

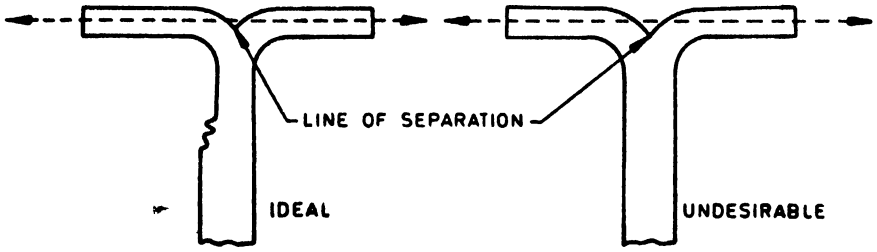

FIG. 1 POSITION OF LINES OF SEPARATION OF PLIES

4.2 Ring Test Piece — The test piece shall be a cylinder, 25 ± 0·5 mm long. Rings having an internal diameter greater than 50 mm shall be cut through and opened to form strip test pieces. The thickness of the ply or layer which is to be separated shall not exceed 6 mm. Where the ply or layer which is to be separated exceeds 6 mm, it shall be brought to the requisite thickness before proceeding with the test. The thickness of this ply shall not be greater than the thickness of the remainder of the test piece.

4.3 Mode of Separation of Plies of Testing — With a sharp-edged cutting tool, carefully slit the strip to a depth of 0·5 mm at the separation interface on the two edges of the strip all along its length. This is to ensure separation at the interface only during the test. Next, detach the parts to be separated first for a sufficient length to permit attachment to the grips of the testing apparatus.

NOTE 1 — Perform the separation without the use of a solvent, if practicable, and without excessive stretching of the rubber. Make the separation a little at a time while the rubber is gripped near the point of separation. If it is necessary to use a solvent in the separating operation, use commercial iso-octane. If iso-octane is used, place the rubber so as to permit free evaporation of the solvent from all parts of its surface, and allow it to rest for at least 1 hour before being tested.

NOTE 2 — The measured adhesion value is to be corrected to 25 mm by measuring the effective width of separation.

5. CONDITIONING OF TEST PIECES AND TEMPERATURE OF TEST

5.1 Cut test pieces shall be conditioned, immediately before testing, for a minimum period of 24 hours at 27 ± 2°C and 65 ± 5 percent relative humidity. The test shall also be done at 27 ± 2°C.

6. TIME LAPSE BETWEEN VULCANIZATION AND TESTING

6.1 Unless specified otherwise, for technical reasons, the following requirements for time lapses shall be observed.

6.1.1 For all test purposes the minimum time between vulcanization and testing shall be 16 hours.

6.1.1.1 Protect the samples and test pieces from light, as completely as possible, during the interval between vulcanization and testing.

6.1.2 For non-product tests, the maximum time between valcanization and testing shall be 4 weeks, and for evaluations intended to be comparable, the test should as far as possible, be carried out after the same time interval.

6.1.3 For product tests, whenever possible, the time between vulcanization and testing shall not be more than 4 months. In other cases, tests shall be made within 2 months of the date of receipt of the product by customer.

7. TESTING METHOD

7.1 Test Machine — The test machine shall be power driven and equipped with a suitable dynamometer. It shall be capable of maintaining a substantially constant rate of traverse of the moving head during the test and fitted with an autographic recorder. An inertialess dynamometer, for example, of electronic or optical type, shall preferably be used.

NOTE — Pendulum-type inertia dynamometers may in fact give different results because of the effects of friction and inertia. When the use of inertia dynamometer is unavoidable, information may be obtained on the adhesion strength in the following way; the capacity of the machine, or the measuring scale selected when a variable range machine is involved, should be such that the separation force read is between 15 and 85 percent of the rated capacity. During the test, the arm of the lever should oscillate freely, like a pendulum, with the catches disengaged.

7.1.1 The accuracy of the machine shall be such that the error in the force measurement as shown and recorded does not exceed 2 percent of the force or 0·4 percent of the maximum of the scale, whichever is the greater.

7.1.2 The machine shall be fitted with grips capable of holding the piece and the ply to be separated without slipping during test.

7.1.3 For testing a ring test piece, a mandrel which is a sliding fit in the test piece, shall be provided. The mandrel shall be capable of being fitted into the non-driven head of the machine so that it shall rotate freely during the test.

7.2 **Cutting Tool** — Maintain the cutting tool carefully so that the edge is sharp enough to avoid leaving rugged edges and pulling outside treads from the fabric.

7.3 PROCEDURE

7.3.1 *Strip Test Piece* — Take the test piece from the conditioning atmosphere and separate a ply of fabric or a rubber layer by hand for a distance of approximately 50 mm. Fix the separated ends of the test piece in the grips of the testing machine, and adjust so that the tension is distributed uniformly and no twisting of the test piece shall occur during the test. Place the body of the test piece in the non-driven grip and the ply to be separated in power driven grip so that the angle of separation is approximately 180°. It is important to ensure that the axis of the strips of the test piece held in the grips lie in the same plane. The rate of travel of the power driven grip shall be 50 ± 5 mm/min or 100 ± 10 mm/min so as to give a rate of ply separation of 25 mm/min or 50 mm/min. Zero the force measuring system and start the machine. Continue the ply separation and record the force over a length of separation of at least 100 mm, the recorder chart having sufficiently large scale to allow easy interpretation of results.

7.3.2 *Ring Test Piece* — Fit the test piece snugly on a mandrel which may be attached to the stationary grip of the machine so that it rotates freely during the test. Attach the ply to be separated to the grip in the power actuated head. Adjust the test piece so that the stress is distributed uniformly, no twisting of the ply to be separated occurs,

and the angle of separation is approximately 90°. Start the machine at a uniform rate of travel of 25 to 125 mm/min. Record the loads causing separation at intervals of 12·5 mm over a distance of 100 mm or the maximum distance possible if the ply is less than 100 mm. Alternatively, take an autographic recording of the test.

7.4 Expression of Results — Determine the median break force (*see* **2.2**), range (*see* **2.3**) and statistical minimum (*see* **2.4**) of peak force values of the trace for adhesion strength or tear strength determine the median break force (*see* **2.2**) and the range (*see* **2.3**) of peak force values by the appropriate method specified in **7.4.1, 7.4.2,** or **7.4.3.** The adhesion strength shall be expressed in kilonewtons per metre width.

NOTE 1 — In applying the methods described in this standard it should be assumed that the trace being evaluated is a time record of the variation of force during the period of test.

NOTE 2 — The measured adhesion values as above are to be corrected to 25 mm by measuring the effective width of separation.

7.4.1 *Condition A* — For traces having less than five peaks. Determine the median, range and statistical minimum of the values of the force peaks in the trace. If there is only one force peak, consider its value to be the median.

7.4.2 *Condition B* — For traces having five to twenty peaks (*see* Fig. 2). Consider only the peak values of the central 80 percent of the complete trace and determine the median peak force, range and statistical minimum of these values.

7.4.3 *Condition C* — For traces having more than twenty peaks (*see* Fig. 3). Draw a series of nine vertical lines, by starting at the centre of the complete trace and drawing four more lines on each side at equal distances of one-tenth of the length of the trace, to the nearest 1 mm. Consider only the peak value situated closest to each of the vertical lines. Determine the median range and statistical minimum of these nine values.

8. REPORT

8.1 The report shall include the following :

a) Adhesion value, that is, median, range, statistical minimum, observed minimum, observed maximum;

b) The type of specimen and thickness of specimen;

c) All observations and recorded data on which the results are based;

d) Date of manufacture or valcanization of rubber, if known;

e) Date of test; and

f) Temperature of the test and its duration, and temperature and relative humidity of conditioning.

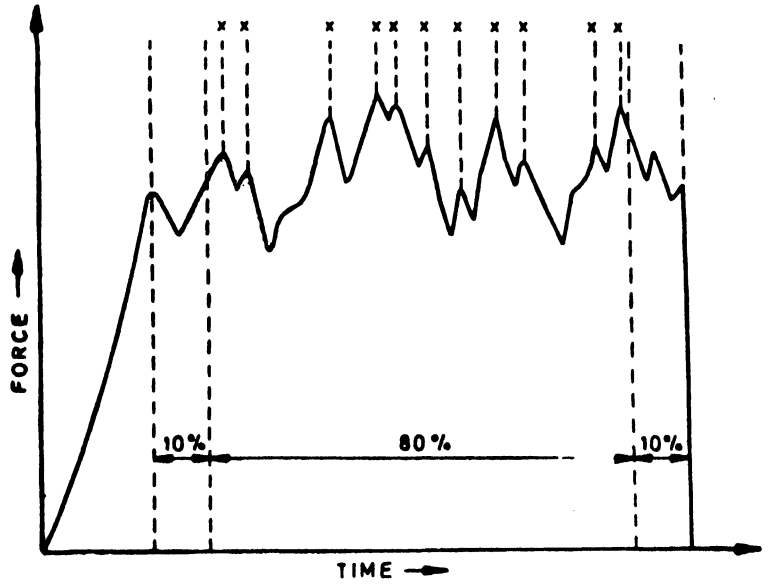

FIG. 2 EVALUATION OF A TRACE WITH FIVE TO TWENTY PEAKS

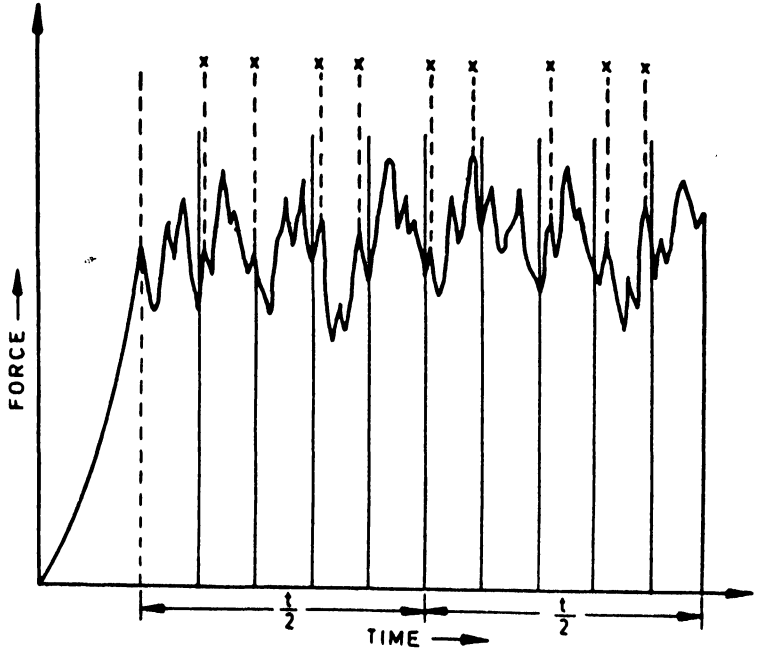

FIG. 3 EVALUATION OF A TRACE WITH MORE THAN TWENTY PEAKS

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